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Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 85/50

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Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 85/50

The Redfish of NAFO Division 3P

by

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Abstract

Low levels of effort persisted on this stock in 1984 and only about 3000 t were taken. The catch rates have been gradually increasing in recent years and research survey data indicate relatively good future recruitment. SPA is not satisfactory because of the low fishing mortalities. General production analyses indicate a yield at 2/3 effort MSY of about 18,000 t.

Résumé

Les efforts concernant ce stock sont restés faibles en 1984 et il n'y a eu que 3 000 t de prises. Les prises ont augmenté graduellement au cours des dernières années et les données d'une enquête indiquent que le recrutement à venir devrait être bon. L'ASP n'est pas satisfaisante à cause de la faible mortalité par pêche. Les analyses générales de la production indiquent un rendement à 2/3 de l'effort de RMS d'environ 18 000 t.

Introduction

Catches of redfish in Div. 3P peaked at about 37,000 t in 1970 but have declined since then to only about 5000 t in 1984. The decrease is not thought to be reflective of stock status so much as an indication of poor market conditions coupled with labor problems in the fishery.

Methods and Results

In recent years, Canada (primarily Nfld.) has taken most of the catch in 3P (Tables 1a and 1b). Although the trend in recent years has been for the majority of the catch to be taken in the second half of the year (Tables 2a and 2b), in 1984 this was reversed due to a strike by trawlermen during this period. Catches in 1984 were about 2:1 for 3Ps:3Pn (Table 3). The historic catches are shown in Fig. 1.

The multiplicative model (Gavaris 1980) was again used this year to standardize the catch rates. As in the past, only those catches of >50% redfish were used but a number of modifications were made. The catch/effort series was re-examined with regard to the country-gear-TC's and changes made concerning those included in the analysis. The revised Maritimes data were incorporated for the first time this year. All catches and effort <10 were deleted from the analysis. These did not appear to cause any bias in the residuals but their removal improved the regression, probably due to the removal of their associated considerable variability. The data were weighted step-wise by effort.

The results (Table 4) indicate significance for the regression. After peaking from the late-60's to the mid-70's, effort has declined (Table 5, Fig. 2). Catch rates (Table 5, Fig. 3) peaked in the mid- to late-60's but then declined. The high rates during that period are thought to be the result of recruitment of the exceptionally strong year-classes of the late-50's. Catch rates have again shown a moderate increase since 1979.

Analytical assessments of this stock in both 1980 (Atkinson et al. MS 1980) and 1981 (Atkinson et al. MS 1981) indicated a catch of 18,000 t when fishing at $F_{0.1}$. Since then, analytical assessments have been attempted but with unsatisfactory results due to the low effort and resultant low F's. The catches remained at such a low level in 1984, that no analytical assessment was even attempted. Instead, a general production model was run using both unlagged data and data lagged 6, 8, 10 and 12 years (Gulland 1961).The results of these analyses are:

MSY	MSY	$EFFORT_{msy}$	2/3 $EFFORT_{msy}$	YIELD 2/3 $EFFORT_{msy}$
nil	regression of CPUE on effort was not significant			
6	20,569	41,386	27,591	18,284
8	19,238	34,342	22,895	17,100
10	18,426	33,024	22,016	16,378

The results of the analysis with a lag of 8 years are shown in Fig. 4 and 5.

The available commercial frequencies (Fig. 6, 7 and 8) were combined (Gavaris and Gavaris 1983) (Fig. 9) then converted to numbers at age (Table 6). It can be seen that fish aged 10 to 18 predominated in the catch. This corresponds to fish 25-35 cm observed in the frequencies. The weight at age has been calculated on an annual basis from 1981-1984 only. The relationships used in all years are:

$$WT(males)=0.01659FL^{2.9548}$$

$$WT(females)=0.01372FL^{3.0210}$$

The estimated catches and weights at age from 1973-1984 are shown in Tables 7 and 8.

Coverage of the area during the spring, 1985 survey was poor due to extensive ice cover. In fact, the estimate of minimum trawlable biomass of redfish approximated the present TAC. For this reason, the numbers at length caught per standard tow (Fig. 10) may not be indicative of the stock structure. If at all representative, however, the indication is of good recruitment to the fishery in a few years.

Conclusions

The high catch rates of the mid- to late-60's are not thought to reflect the long term norm for this stock but instead are believed to be the result of the very strong year classes of the late-50's and are therefore above the long term average to be expected. The recent increase in the catch rates tends to indicate a healthy stock and the research vessel data for 1985 suggest that there may be good recruitment to the fishery a few years down the road. There does not appear to be any data suggesting a change in the TAC for 1986 from the present level of 18,000 t.

References

Atkinson, D.B., McKone, W.D. and W.E. Legge MS 1980. 3P Redfish Assessment. CAFSAC Res. Doc. 80/60.

Atkinson, D.B., Legge, W.E. and P. Stead MS 1981. The Redfish Stock in NAFO Division 3P. CAFSAC Res. Doc. 81/59.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Gavaris, S. and C.A. Gavaris 1983. Estimation of catch at age and its variance for groundfish stocks in the Newfoundland Region. In Sampling Commercial Catches of Marine Fish and Invertebrates. W.G. Doubleday and D. Rivard ed. Can. Spec. Pub. Fish. Aquat. Sci. 66pp 178-182.

Gulland, J.A. 1961. Fishing and stocks of fish at Iceland. U.K. Min. Agric. Fish. Food, Fish. Invest. (Ser. 2) 23(4): 52 p.

Table 1a. Division 3Pn redfish catches by country and gear.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
Can(MQ)(M)[c]	353	1,520	3,941	2,735	932	743	37	30	108	311	540	861
Can(N)	3,115	2,559	3,505	2,925	1,283	2,266	2,676	2,154	3,749	3,508	2,385	379
Can(Q)	-	-	-	-	-	-	384	165	387	-	-	-
Fr(M)	-	53	27	8	-	1	1	-	11	-	-	-
Fr(Sp)	-	24	571	236	270	32	62	23	1	1	68[b]	-
FRG	-	-	-	-	-	-	-	-	-	-	-	-
Japan	-	-	6	-	-	-	-	-	-	-	-	-
Portugal	186	105	50	-	-	-	-	-	-	-	-	-
U.K.	-	3	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	28	-	-	-	-	-	-	-	-
Total	3,654	4,264	8,100	5,932	2,485	3,042	3,160	2,372	4,256	3,820		1,240

[a]Provisional.
[b]Includes Division 3Pn+3Ps.
[c]Maritime and Quebec catches were combined prior to 1979.

Table 1b. Division 3Ps redfish catches by country and gear.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
Can(MQ)(M)[c]	1,131	513	2,549	3,242	3,730	2,592	970	360	391	515	670	396
Can(N)	9,978	4,999	8,744	7,948	9,489	9,282	5,119	4,609	4,123	1,553	2,316	1,608
Can(Q)	-	-	-	-	-	-	248	-	-	-	-	-
Fr(M)	-	147	60	6	8	14	21	112	124	5	-	-
Fr(Sp)	155	200	571	1,071	1,437	315	101	111	47	17	68[b]	=
FRG	-	-	-	-	-	-	-	-	-	-	-	-
GDR	-	-	-	-	-	-	-	-	-	-	-	-
Japan	444	601	-	8	-	-	-	-	-	-	-	-
Portugal	-	90	101	10	-	-	-	-	-	-	-	-
Spain	-	-	10	13	-	-	-	-	-	-	-	-
U.K.	7	-	3	-	-	-	-	-	-	-	-	-
USSR	2,999	11,344	8,112	911	14	-	-	-	-	-	-	-
Ireland	-	-	-	26	-	-	-	-	-	-	-	-
Total	14,714	17,894	20,150	13,235	14,678	12,203	6,459	5,192	4,685	2,090		2,004

[a]Provisional.
[b]Includes Division 3Pn+3Ps.
[c]Maritime and Quebec were combined prior to 1979.

Table 2a. Division 3Pn redfish catches by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Unknown	Total
1973	53	192	892	381	3	298	102	230	664	303	234	302	-	3,654
1974	660	643	149	21	32	142	133	55	108	203	1,508	610	-	4,264
1975	1,944	445	224	744	21	61	273	1,146	2,764	340	104	34	-	8,100
1976	281	511	1,370	1,892	469	281	509	371	130	91	19	8	-	5,932
1977	146	108	373	74	71	291	102	459	613	89	71	88	-	2,485
1978	6	339	674	38	10	77	160	549	392	55	491	251	-	3,042
1979	17	142	598	354	74	92	210	168	167	372	570	396	-	3,160
1980	5	38	279	193	12	155	388	196	173	192	360	381	-	2,372
1981	9	432	100	315	117	160	969	540	498	753	272	91	-	4,256
1982	-	1	39	13	10	153	502	288	923	652	959	280	-	3,820
1983[a]	21	59	30	207	1	217	294	622	791	144	356	183	-	2,925
1984[a]	-	534	211	115	11	37	65	9	-	205	-	53	-	1,240

[a]Provisional Canada (N+M) only

Table 2b. Division 3Ps redfish catches by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1973	445	331	2,451	425	239	1,720	2,514	2,552	1,381	836	630	1,190	14,714
1974	1,077	1,317	3,378	3,328	487	2,463	2,162	1,029	689	838	667	459	17,894
1975	911	357	657	847	2,546	1,846	3,072	3,527	2,589	1,731	1,104	963	20,150
1976	363	371	1,729	1,272	714	2,414	2,970	2,282	822	211	66	21	13,235
1977	80	388	1,348	694	506	2,408	1,848	1,782	1,846	2,010	1,307	461	14,678
1978	31	301	899	396	148	903	1,625	2,029	1,892	2,178	1,066	735	12,203
1979	30	53	459	881	140	886	951	1,005	690	587	618	159	6,459
1980	6	72	347	469	174	257	978	1,130	706	335	339	379	5,192
1981	21	537	763	157	217	897	465	937	134	150	224	183	4,685
1982	4	5	27	127	154	133	220	580	193	398	205	44	2,090
1983[a]	8	11	25	27	75	61	132	462	667	953	168	394	2,986
1984[a]	9	126	167	38	114	471	802	141	40	50	22	24	2,004

[a]Provisional Canada (N+M) only.

Table 3. Summary of redfish catches in Division 3P.

Year	3Pn	3Ps	Total	
1959	9	3,774	3,783	
1960	14	9,211	9,225	
1961	1,060	8,340	9,400	
1962	2,132	11,306	13,438	
1963	2,597	11,150	13,747	
1964	4,688	9,119	13,807	
1965	8,802	9,931	18,733	
1966	4,325	16,543	20,868	
1967	4,526	28,465	32,991	
1968	2,642	11,242	13,884	
1969	3,324	28,727	32,051	
1970	3,689	33,581	37,270	
1971	966	26,534	27,500	
1972	639	25,398	26,037	
1973	3,654	14,714	18,368	
1974	4,264	17,894	22,158	
1975	8,100	20,150	28,250	
1976	5,932	13,235	19,167	
1977	2,485	14,678	17,163	
1978	3,042	12,203	15,245	
1979	3,160	6,459	9,619	
1980	2,372	5,192	7,564	
1981	4,256	4,685	8,941	
1982	3,820	2,090	5,910	
1983[a]	2,925	2,986	5,911	
1984[b]	1,240	2,004	3,244	5,244[c]

[a]Provisional.

[b]Provisional with Canadian data only.

[c]Including foreign allocation of 2000 t.

Table 4: Regression of multiplicative model for redfish in Div.3P.

multiple r.....0.720
multiple r squared.....0.519

analysis of variance

source of variation	df	sums of squares	mean squares	f_value
intercept	1	2.947e2	2.947e2	
regression	30	1.755e2	5.850e0	43.183
type 1	4	8.653e1	2.163e1	159.679
type 2	1	5.124e0	5.124e0	37.822
type 3	25	7.722e1	3.089e0	22.801
residuals	1201	1.627e2	1.355e-1	
total	1232	6.329e2		

Table 5: Predicted catch rate for redfish in Div.3P, 1959-1984.

year	total catch	catch rate mean	s.e.	effort
1959	3783	0.692	0.086	5463
1960	9225	0.611	0.056	15089
1961	9400	0.567	0.040	16578
1962	13438	0.575	0.035	23357
1963	13747	0.761	0.041	18072
1964	13807	0.763	0.053	18100
1965	18733	0.968	0.067	19351
1966	20868	0.993	0.063	21011
1967	32991	0.864	0.044	38197
1968	13884	0.827	0.054	16785
1969	32051	0.804	0.048	39852
1970	37270	0.710	0.041	52527
1971	27500	0.590	0.041	46628
1972	26037	0.589	0.035	44216
1973	18368	0.626	0.029	29343
1974	22158	0.545	0.027	40636
1975	28250	0.537	0.023	52622
1976	19167	0.445	0.019	43118
1977	17163	0.447	0.019	38361
1978	15245	0.441	0.018	34550
1979	9619	0.395	0.018	24335
1980	7564	0.482	0.025	15706
1981	8941	0.429	0.024	20834
1982	5910	0.516	0.034	11461
1983	5911	0.632	0.043	9352
1984	3244	0.571	0.045	5682

Table 6: Estimated numbers of redfish caught at age during the fishery in Div.3P, 1984.

	average		catch		
age	weight	length	mean	std. err.	c. v.
* 6	0.082	17.729	63	15.43	0.24
7	0.113	19.749	324	54.70	0.17
8	0.148	21.580	350	75.47	0.22
9	0.176	22.959	409	95.27	0.23
10	0.202	24.019	1123	161.25	0.14
11	0.234	25.165	2058	212.35	0.10
12	0.275	26.569	1347	198.60	0.15
13	0.308	27.557	1146	177.39	0.15
14	0.346	28.709	923	147.19	0.16
15	0.350	28.924	723	117.28	0.16
16	0.404	30.216	759	112.97	0.15
17	0.417	30.556	629	102.80	0.16
18	0.457	31.394	659	99.76	0.15
19	0.519	32.746	372	67.60	0.18
20	0.538	33.196	234	50.76	0.22
21	0.575	33.888	170	40.12	0.24
22	0.544	33.320	132	37.81	0.29
23	0.627	34.902	121	31.66	0.26
24	0.598	34.503	133	30.28	0.23
25	0.638	35.066	146	34.95	0.24
26	0.673	35.698	297	45.06	0.15
27	0.795	37.694	108	24.66	0.23
28	0.780	37.504	136	27.28	0.20
29	0.854	38.763	53	15.32	0.29
*30	0.921	39.475	243	30.17	0.12

* For the ages flagged by * there was an age length key with only one age determination for some length. Since the variance formula has n-1 in the denominator, it cannot be evaluated for this length. Consequently this variance component is not included in the variance for the flagged ages. This is generally not a serious problem since it occurs when few fish are caught at that length.

Table 7: Catch at age matrix for redfish from Div.3P, 1973-1984.

catch at age

age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
6	13	105	401	41	257	1339	440	191	8	3	8	63
7	11	895	694	56	491	4146	1510	976	204	11	10	324
8	16	1876	1868	263	499	7359	2703	1776	1550	76	8	350
9	8	1647	883	581	790	7382	2859	2377	1923	234	58	409
10	20	1528	486	386	835	5203	1606	1929	1686	250	188	1123
11	536	1830	1112	434	777	2358	896	1532	1344	606	232	2058
12	1004	1399	623	506	971	2049	1020	1219	1236	856	404	1347
13	3076	3602	1016	990	849	857	714	629	1327	943	602	1146
14	6099	3058	1123	1119	1022	1085	710	802	635	1315	956	923
15	9314	3173	2206	1072	1438	1162	496	579	518	1042	1064	723
16	5866	7661	3613	1796	793	927	449	313	384	940	1130	759
17	7300	2597	8428	1124	1298	791	603	366	348	458	939	629
18	1842	3930	6040	4154	1005	1067	548	308	304	322	1178	659
19	878	1063	12060	1897	2659	852	531	315	399	233	612	372
20	1149	1326	3015	6345	1490	1883	655	319	374	151	567	234
21	589	701	2323	1463	4659	520	1021	428	286	188	483	170
22	385	1555	2080	2387	2281	1534	676	809	510	207	342	132
23	404	2821	1758	1957	2398	1040	1263	484	876	194	270	121
24	484	1410	790	1310	2031	1080	731	796	521	302	271	133
25	168	2147	1205	2269	1083	1053	1053	482	1021	393	270	146
26	2	1887	995	1613	619	674	691	490	688	575	218	297
27	2	2	687	868	396	532	454	239	649	386	430	108
28	2	2	2	575	307	339	345	287	450	411	251	136
29	2	2	2	2	289	187	207	171	371	342	266	53

Table 8: Average weight at age of redfish caught in Div.3P, 1973-1984.

average weight at age

age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
6	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.06	0.08	0.08
7	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.10	0.11	0.11
8	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.16	0.15
9	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.21	0.18
10	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27	0.27	0.26	0.20
11	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.33	0.27	0.23
12	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.36	0.32	0.28
13	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.37	0.35	0.31
14	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.40	0.38	0.35
15	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.42	0.39	0.35
16	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.44	0.41	0.40
17	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.45	0.42
18	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.54	0.52	0.46	0.46
19	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.62	0.57	0.49	0.52
20	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.63	0.60	0.50	0.54
21	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.60	0.66	0.53	0.58
22	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.65	0.67	0.58	0.54
23	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.65	0.70	0.61	0.63
24	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.71	0.68	0.67	0.60
25	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.73	0.71	0.68	0.64
26	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.78	0.75	0.74	0.67
27	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.81	0.85	0.71	0.80
28	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.87	0.82	0.82	0.78
29	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.88	0.93	0.85	0.85

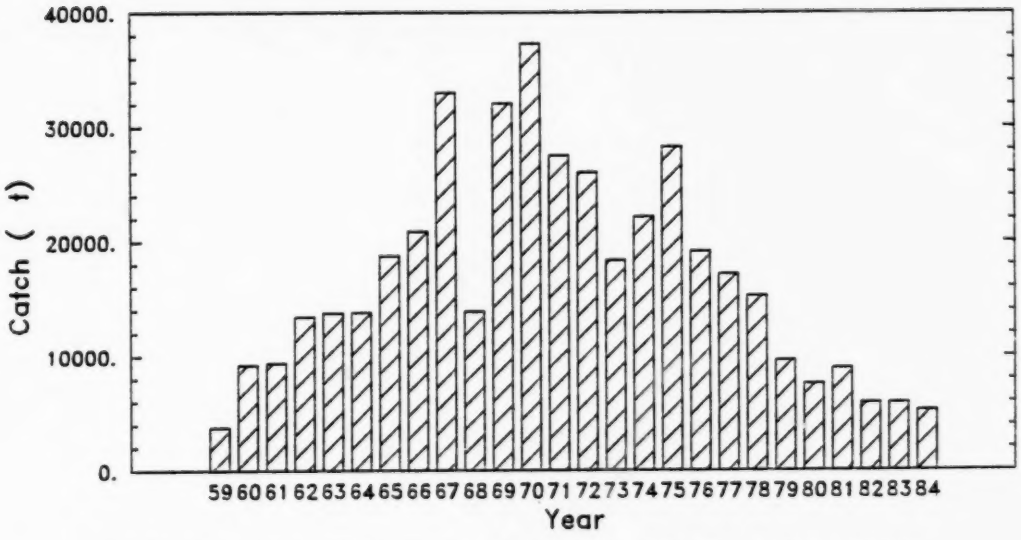

Fig.1: Nominal catches of redfish in Div.3P, 1959–1984.
(1983 and 1984 Provisional)

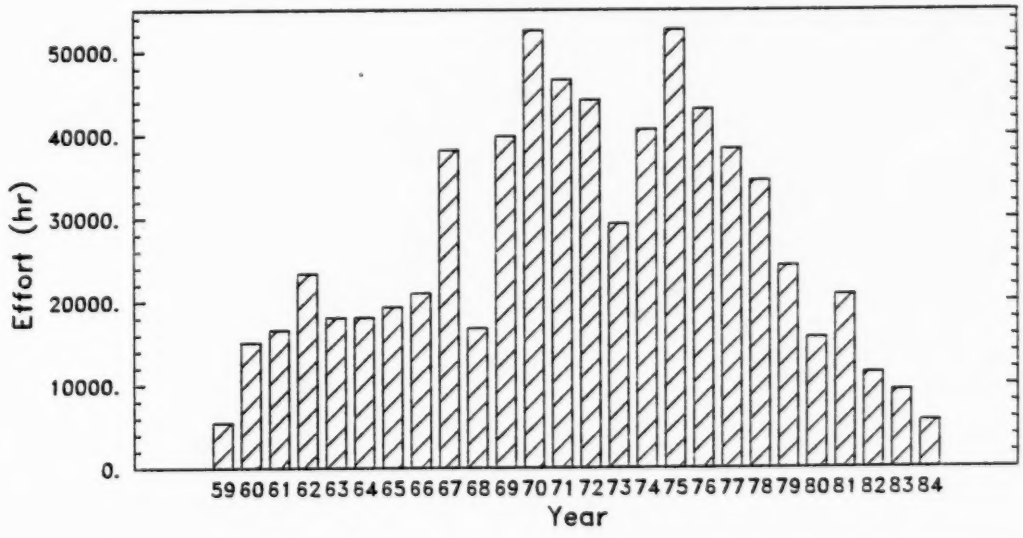

Fig.2: Standardized directed effort for redfish, Div.3P, 1959–1984.
(1983 and 1984 Provisional)

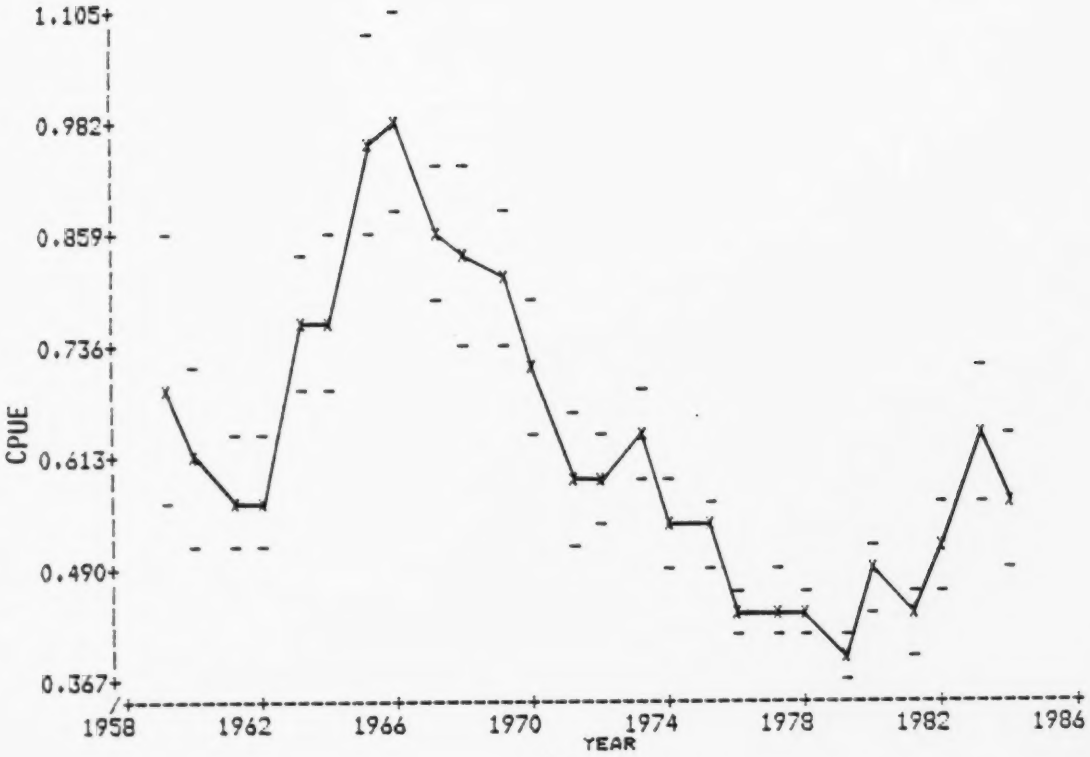

Fig. 3: Standardized CPUE (t/hr) for redfish in Div.3P, 1959-1984.
(1983 and 1984 Provisional)

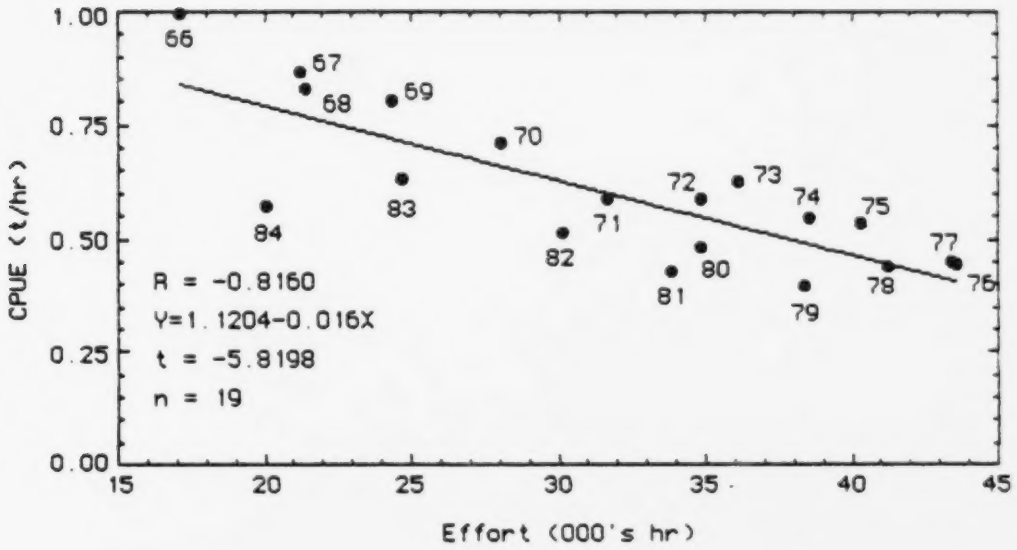

Fig.4: Regression of standardized CPUE on standardized effort for redfish in NAFO Div.3P using data lagged 8 years.

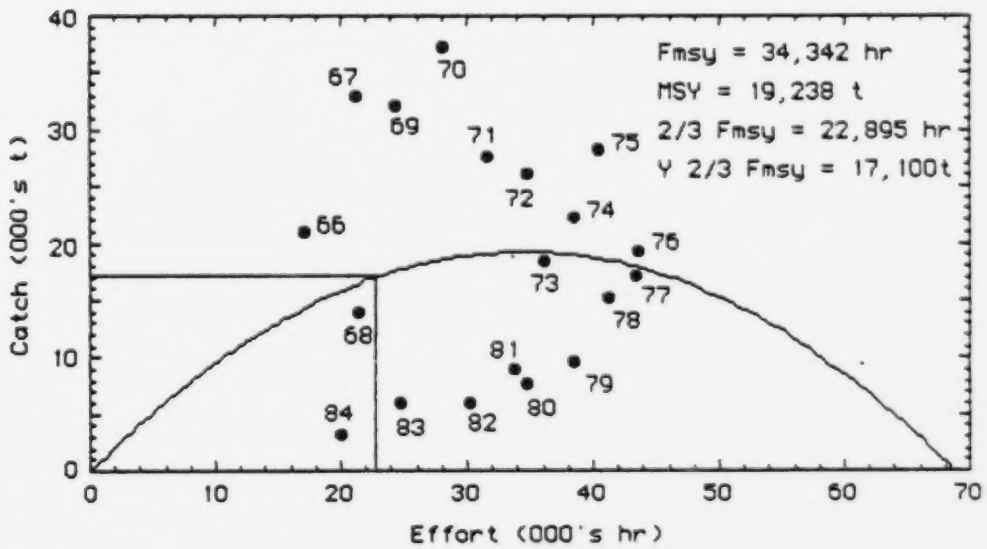

Fig.5: General production curve derived from regression of Fig.4.

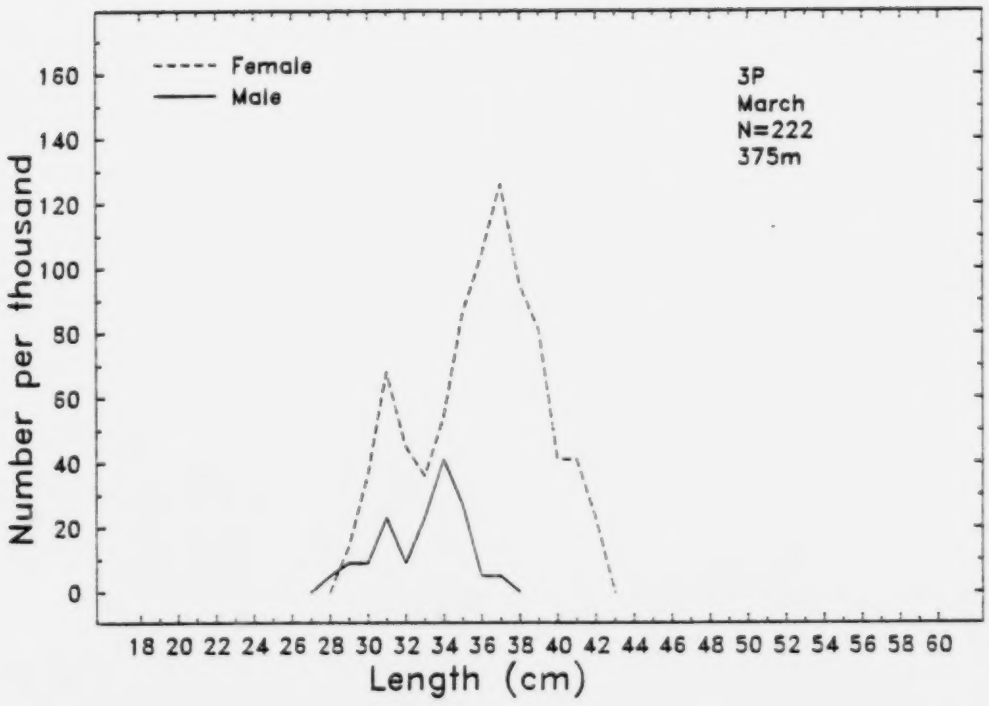

Fig.6: Commercial frequencies from Can.(SF) otter trawl redfish fishery in Div.3P in 1984 (port sampling).

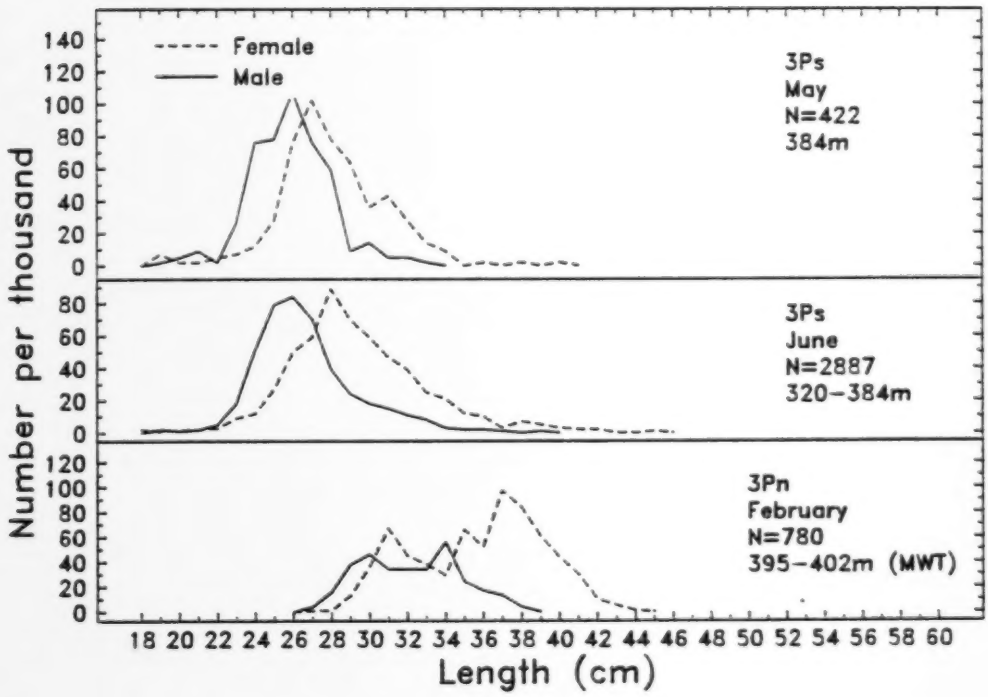

Fig.7: Commercial frequencies from Can (Nfld) otter and midwater trawl redfish fishery in Div.3P in 1984 (port sampling).

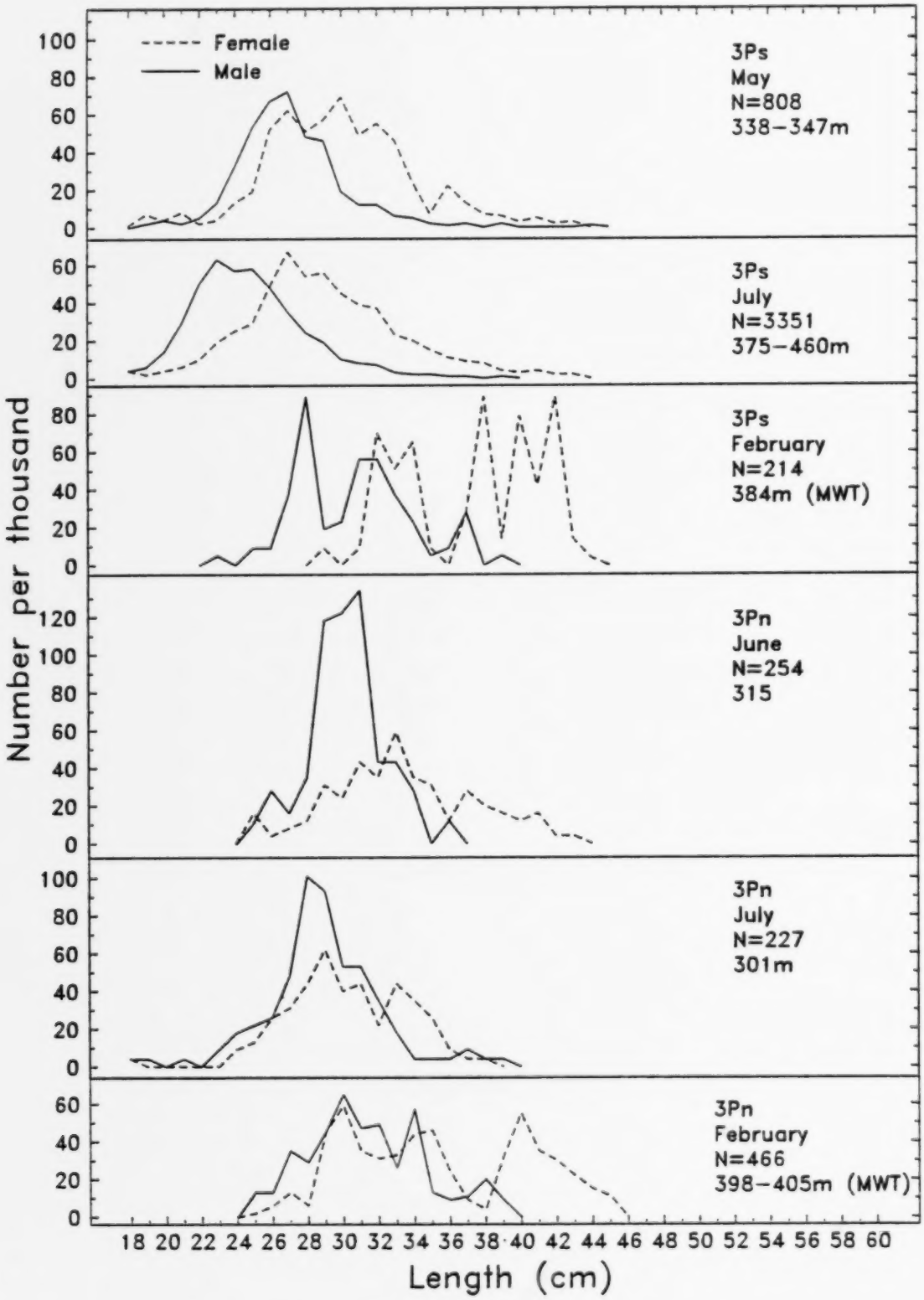

Fig.8: Commercial frequencies from Can (Nfld) otter and midwater trawl redfish fishery in Div.3P in 1984 (sea sampling).

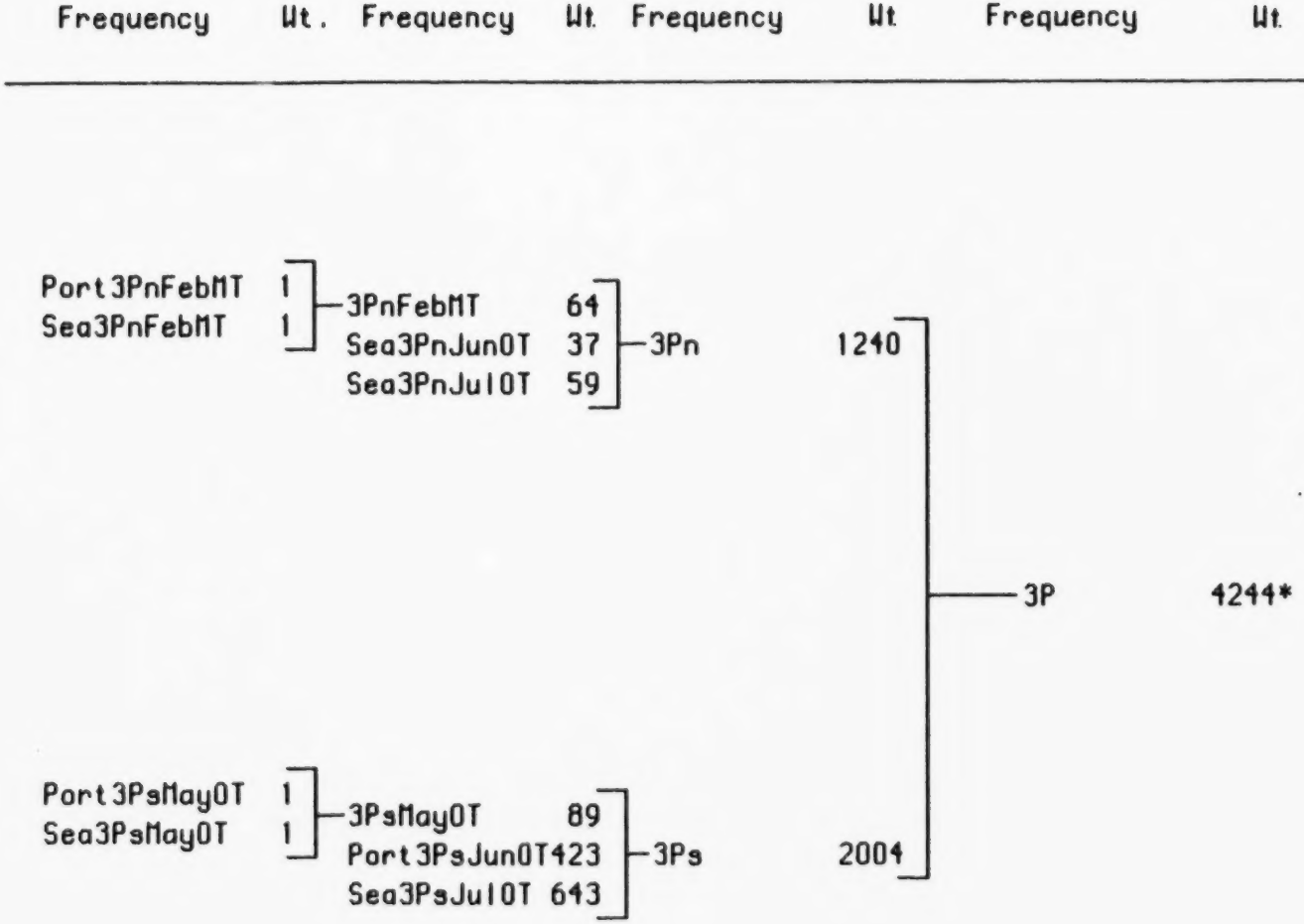

Fig.9: Commercial frequencies used and the process of combining them to derive the number of redfish caught at age in Div. 3P, 1984.

* includes 50% of EEC allocation (no provisional 1984 data available).

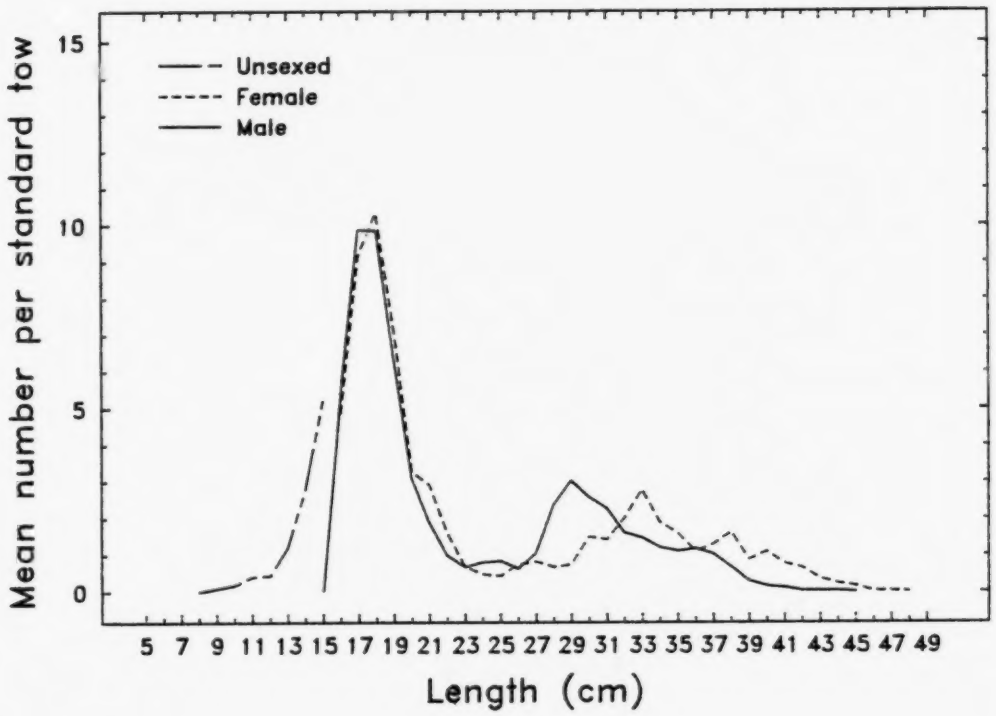

Fig.10: Mean number of redfish caught at length per standard tow during research cruise in Div.3P in 1985.